THE PULSE HYPOTHESIS IN THE ESTABLISHMENT OF *ARTEMISIA* SEEDLINGS AT PAHUTE MESA, NEVADA

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Abstract.— New *Artemisia* seedlings are not established each year. Many that are established fail to survive be cause of unfavorable rainfall in succeeding years. A total of 184 young plants was examined for the number of annua growth rings to ascertain the year of establishment after all vegetation had been killed near the time of a nuclear tes event in 1965. The three most important recent years for establishment and survival of new seedlings (as of 1976 an based on a sample of 184 plants) were 1966 (9 percent), 1969 (29 percent), and 1973 (36 percent). A total of 2 percent was established in the other years from 1965 to 1976. These three years were also the years with high rainfal input during preceding winter and spring months. If old plants are killed, seeds germinate with much lower input of precipitation. Many seedlings germinated in 1968 at a site where old ones had been burned off even though th rainfall was not favorable. Plants of a given age varied greatly in size according to their competition. Seedlings ge minating in old stands grew little in comparison with those germinating in areas where old plants had been kille One exception was an area where intense competition occurred due to large numbers of new plants, resulting i growth restriction on all plants.

It is generally considered that favorable rainfall years are necessary for the establishment of perennial plants under desert conditions (Beatley 1975, Wallace and Romney 1972). There is some question about the need for more than one favorable year in succession for establishment of new plants, at least under some circumstances (Wallace and Romney 1972). Studies made of ages or size of desert perennial plants most often indicate a rather uniform distribution of the input of new perennial plants (El-Ghonemy et al. 1979, this volume). Such studies, however, are obscured by the fact that differences in shrub size tend to disappear after a few years. The present study was undertaken because data for precipitation for recent years are available for Pahute Mesa, and because *Artemisia* can be dated by counting annual growth rings (Ferguson 1960).

Materials and Methods

The Pahute Mesa area of the Nevada Test Site is located at an elevation of about 2000 m. The predominant vegetation in many areas of it is *Artemisia tridentata* Nutt. an *Artemisia nova* A. Nels. (Beatley 1975, 1976 Revegetation studies following nuclear test ing have been conducted there previousl and the age of many of the plants in stud plots is determined by knowledge of whe they germinated (Wallace and Romne 1972). The past 12 years of the history of th area is fairly well known. By 1976 some o the known seedlings had attained the size o many other plants in the population, eve though they were much younger. This infor mation was useful in determining the plant which should be sampled. On 15 July 1976, total of 184 plants was measured by dimen sion analysis using methods reported (Wal lace and Romney 1972), and then cut and e amined for ring count (Ferguson 1960 Sampling was done at five different sites e tablished to track vegetation recovery fro the Palanquin and Cabriolet plowshare test (Rhoads et al. 1969). Dates of these nuclea tests were April 1965 and January 196 Plant weight by dimension analysis was ca culated from the regression of weight = 3479V + 0.081. V is volume in m^3; weight i in g dry weight.

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RESULTS AND DISCUSSION

Seedlings that initially germinated in areas where vegetation was killed by the 1965 Palanquin test were essentially all destroyed in the drought of 1968. It was determined at that time that rabbits had eaten the plants in a desperate attempt for their own survival (Wallace and Romney 1972).

Results obtained from the 1976 sampling are presented in Table 1. The first year of most pronounced establishment of seedlings after disturbance was in 1969, except at Cabriolet where germination occurred one year earlier (1968). The Cabriolet event was in January 1968 and by spring and summer months the pressure of old plants using the available soil moisture was absent in the newly killed area. Fallout radiation destroyed nearby standing vegetation, but not the seed supply in soil. As a result, the old seeds were available for germination in the spring of 1968, when soil moisture became more plentiful due to death of the old plants.

The year 1969 was one of high rainfall in February, resulting in extensive germination

TABLE 1. Number, size, and age of 184 young *Artemisia* plants from Pahute Mesa according to dimensional measurements and annual ring counts.

	No. of plants	No. of rings	1976 mean above-ground dry wt per plant g dry weight	Coefficient of variation weight Percent	Year of germination
		Normal vegetation (control)			
	1	15	59.9	–	1961
	12	10	14.76	17.64	1966
	13	7	12.28	18.76	1969
	5	6	5.57	1.42	1970
	5	3	0.37	0.16	1973
	11	2	0.16	0.10	1974
Total	47	–	–	–	–
		Adjacent to roadside in control area			
	2	10	154.4	67.6	1966
	20	7	49.9	57.9	1969
	2	3	0.24	0.02	1973
	1	1	0.08		1975
Total	25	–	–	–	–
		Palanquin partially killed area (1965)			
	13	7	244.6	244.8	1969
	3	5	64.4	34.3	1971
	37	3	8.2	9.7	1973
	1	2	0.17	–	1974
Total	54	–	–	–	–
		Palanquin totally killed area (1965)			
	5	10	567.3	218.3	1966
	3	7	185.4	58.7	1969
	1	2	0.42	–	1974
	19	3	4.55	7.09	1973
	1	4	188.1	–	1972
Total	29	–	–	–	–
		Cabriolet totally killed area (1968)			
	22	8	7.82	2.18	1968
	4	7	7.88	2.27	1969
	3	3	8.10	2.15	1973
Total	29	–	–	–	–

of new seedlings that survived in large numbers. The years 1966, 1969, and 1973–74 were also good years for establishment of seedlings in both control and disturbed areas. Area 12 Mesa station recorded 24.7 cm of rainfall in the 1968–1969 season and 18 cm in the 1972–1973 season. The November and December rainfall for 1965 was about 9 cm, and the relatively cool spring months made 1966 a favorable year. Tueller and Clark (1976) reported similar precipitation data for the Pahute Mesa area.

Most seedlings established on a scraped roadside installed in 1965 were related to the high rainfall year of 1969.

The percentages of the total new plants for all areas for the three most important years were 9 (1966), 29 (1969), and 36 (1973). Results confirm the idea that new seedlings in this ecosystem truly come in pulses related either to rainfall or to disturbance that kills old plants and makes more favorable soil moisture for the seedlings.

The sizes of the plants in Table 1 are of considerable interest. They differ considerably for given ages, a fact related to natural competition in the environment. Even after 7 and 10 years, plants in old, nondisturbed areas were still small and had survived with difficulty. They were usually close to old plants even though in disturbed areas most germination was between old plants (Wallace and Romney 1972). These new plants may remain small until old ones die naturally. In disturbed areas plants of the same age were much larger, except in the Cabriolet area, where so many seedlings germinated that competition kept them small. Seedlings also remained small in the control area, where a normal stand of vegetation was present.

There seems to be a niche among old, established plants where new ones become established and await the chance to replace the older plants.

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